Trade-imbalances networks and exchange rate adjustments: the paradox of a new Plaza

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March 2009

Abstract

This paper addresses the issue of a coordinated adjustment plan ("new Plaza") to close global imbalances. We show that the complexity of the network of bilateral trade imbalances has increased, revealing that any plan focusing on industrialised countries only is likely to be ineffective. By proposing new effective exchange rate measures based on bilateral imbalances, we show that exchange rate movements against debtor and creditor countries have not been consistent with the simultaneous closing of all bilateral positions. The difficulty to orchestrate a plan involving many partners is thus matched by the apparent inability of uncoordinated adjustments to close the imbalances.

JEL Codes: F31, F33, F42

Keywords: Plaza agreement, exchange rates, global imbalances, network analysis

The authors blame each other for any remaining mistakes. They nevertheless agree on the need to thank Giorgio Fagiolo for sharing the codes used for network analysis, and participants to the "NetWorkShop" at the Sant'Anna School of Advanced Studies, Pisa, and to the MacroSeminar at the Department of Economics at the University of Trento for insightful comments.

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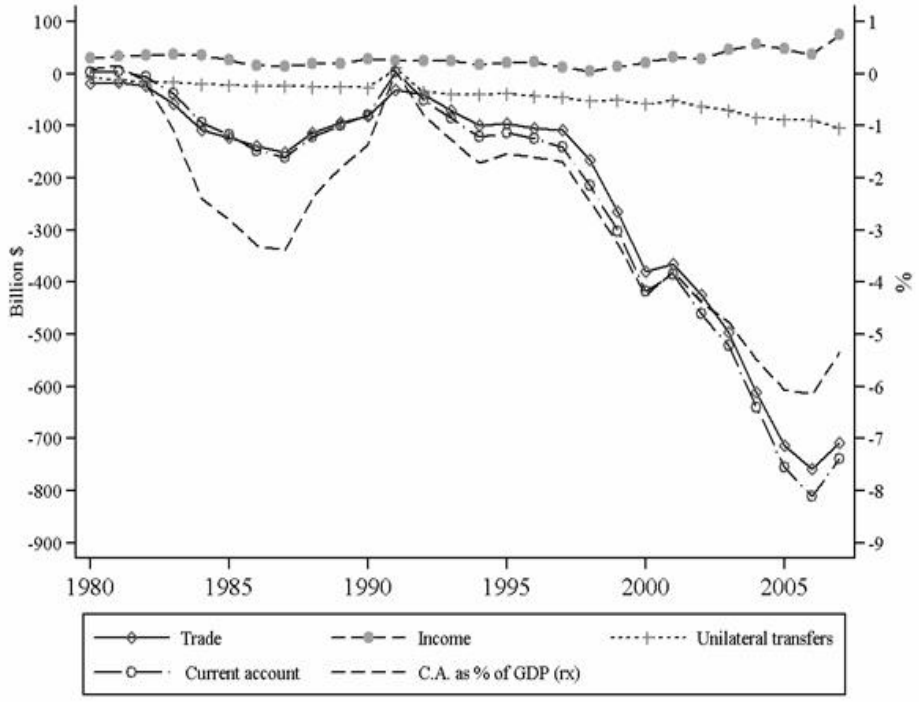
1 Introduction

The Unites States has been running large trade and current account deficits since almost two and a half decades. Their size has grown remarkably (both in absolute and in relative terms) since the early 2000s and peaked in 2006 at $ 811 billion, i.e. 6.15% of the US GDP (see Figure 1).[1] The debate regarding the causes of the evolution of the US current account balance has been long and lively. Ultimately, a consensus has emerged on a few key factors: the overvaluation of the US dollar, in particular vis à vis the currencies of a number of emerging market economies; the expansionary economic policy measures undertook in the US after the year 2001; the financial underdevelopment of many emerging economies, together with their massive accumulation of foreign reserves; the extraordinary increase in the price of the primary commodities whose production is concentrated in few emerging markets.[2]

Figure 1: The U.S. current account and its components. 1980–2007



Such an interpretation seems not much contested anymore, in particular after the emergence of the financial crisis in mid-2007. Nonetheless, disagreement remains as to what measures policymakers should undertake both to support the needed process of

[1]The largest part of the annual deficits is due to trade imbalances, while unilateral transfers and income payments tend to offset each other.
[2]See Fracasso (2007) for a more detailed discussion.

adjustment and to prevent the latter from occurring in a disorderly manner (Blanchard et al., 2005; Rogoff, 2006; Engel and Rogers, 2006; Obstfeld and Rogoff, 2007; Cooper, 2008).

A number of economists (see for instance Cline, 2005a,b; Bergsten, 2008) have argued in favour of a new international exchange rate agreement among the major countries, aiming to achieve the realignment of exchange rates at the worldwide level. Such advocated plan has been dubbed as "new Plaza" after the famous agreement reached in 1985 by the representatives of the countries of the G-5 to produce a gradual and steady adjustment of the dollar against the currencies of the US major trade partners. The global nature of the imbalances, is argued, calls for international policy coordination.

Not all economists have agreed with this proposal. Some have argued that coordinating exchange rate interventions is more difficult in recent times than it was in the 1980s. The number of parties involved in the imbalances is far larger and this would require more demanding negotiations, harder evaluations of the optimal exchange rates and stronger enforcement mechanisms that, incidentally, are not in place at the moment. A large devaluation of the dollar on a trade-weighted basis may dent current account imbalances only if most countries intervene contemporaneously and in a coordinated manner: all bilateral exchange rates need move in the appropriate way if one wants to close/reduce all imbalances at the same time.

The recent debate on the evolution of the US dollar against the currencies of the main US trade partners fully reflects the complexity of the global network of bilateral trade imbalances. On the one hand, in the face of a large and steady depreciation of the dollar against the euro, European policymakers expressed concerns for the region's loss of competitiveness.[3] On the other hand, given the limited contraction of the US deficit in 2007, further depreciation has been invoked by the US authorities. Such contrasting claims are not at odds: the limited and delayed impact on the US current account and trade balance of the depreciation of the dollar may be the result of its differentiated adjustment against the diverse trading partners and of other technical reasons pointed out by Milesi-Ferretti (2008). Thus, the often advocated additional depreciation of the dollar is not inconsistent with the recent favourable evolution of the US effective exchange rate.

Notwithstanding the debate arisen around the new Plaza proposal, little empirical research has so far been conduced to shed light on the degree of complexity of the trade

[3]In addition, many have shown concerns for the asymmetric effects of US imbalances and of the dollar depreciation on the East Asian economies (see Mazier et al. 2008).

imbalances network and on its relations with the movement of the bilateral exchange rates.[4] As recently pointed by Fratzscher (2008a, p. 366) "the key question is what global exchange rate configurations will be in a world in which global current account imbalances are adjusting." In this work we shall tackle this issue by means of a complex network analysis and developing two indices of imbalances-weighted exchange rates.

More precisely, the paper unfolds as follows. We shall start in Section 2 with a brief discussion of the global imbalances at the time of the Plaza agreement and in the 2000s. Section 3 will discuss how the network of trade imbalances has changed over time, both in the number of its members and in their relationships. This will facilitate the appraisal of its much discussed, yet little measured degree of complexity. In Section 4 we shall address the evolution of the exchange rates in the period 2002–2006. We shall develop and examine two new trade-imbalances-weighted exchange rate indices. We shall then compare them with the (more traditional) trade-weighted effective exchange rates of the Bank of International Settlements (BIS). This tentative exercise, to our knowledge new, will help to assess the consistency of the movements of the bilateral exchange rates with the goal of closing/reducing all bilateral trade imbalances. In Section 5 we shall draw two main conclusions from our results. First, due to the large differences in the global economic trade-imbalances networks in the two decades, we warn that the parallelism of the current situation with that in the 1980s is somehow misleading. Second, in the light of the fact that the recent, uncoordinated exchange rate movements did not tackle trade imbalances in a mutually consistent way, and given the high complexity of the current trade imbalances network, we argue that a paradox emerges. The increased interdependence among countries makes coordination harder to achieve, yet more necessary.

We would like to emphasise at this stage that the analysis we shall thus offer has no specific normative ambition. We claim neither that exchange rates are the most important factors in redressing global imbalances, nor that all bilateral trade imbalances require to be simultaneously closed.[5] In addition, it does not investigate the determinants of exchange rate levels and fluctuations, and thus makes no reference to the role of capital flows in facilitating or preventing nominal adjustments. As stressed above, we aim to investigate the

[4]The most notable exception is represented by Dekle et al. (2007) which look at the consequences and welfare implications of closing global bilateral imbalances. In addition, Berthou (2008) and Thorbecke (2008) look, respectively, at bilateral exchange rates among OECD countries and triangular trading patterns in Asia.

[5]Unfortunately, economic theory says nothing on the optimal number of imbalanced relations a country should run and little on the dynamically optimal value of net current account positions. Thus, there is no clear benchmark against which to compare the current situation.

degree of complexity of the trade imbalances network and to discuss its relations with the uncoordinated movement of the bilateral exchange rates in the last few years.

2 Global imbalances: from the mid 1980s to the early 2000s

After a gradual but steady improvement in the late 1980s, and a short-lived positive balance in 1991, the US started again to run large and growing trade and current account deficits in 1992. Although the dollar declined against a number of currencies since 2002, the US trade and current account balances at the end of 2005 were still badly unbalanced. For this reason, the proposal of a new Plaza agreement emerged in 2005. One can find two main rationales for such proposal: the dollar was considerably overvalued on a trade-weighted basis and the pattern of its "uncoordinated" devaluation against the foreign currencies was inappropriate. Cline (2005b) and other economists argued that markets should not be left alone in setting the adjustment process because only coordination efforts may reduce the spillovers of the bilateral exchange rate adjustments on third parties.

Even letting aside the political issues that may prevent such a large and variegated number of countries from converging on a clear and uniquely identified exchange rates realignment plan, two major objections to the new Plaza proposal have been raised. The first one stresses that the number of countries involved in the building up and in the maintenance of the global imbalances is much larger than that observed in 1985. The plan would require the daunting identification of a matrix of optimal bilateral exchange rates able to a) redress global imbalances (and in particular the US external deficits), and b) produce fluctuations of the bilateral exchange rates smaller than the variations to the overall trade-weighted rates. The second objection refers to the fact that while exchange rates do influence current account and trade balances, they are not their unique or even main determinants (McKinnon and Schnabl, 2006). Domestic macroeconomic policies are as important as exchange rates, but much more difficult to coordinate, also because of the increasing importance of a number of big emerging markets.[6] Both the objections above revolve around the following observation: the world economic environment has deeply

[6]A tangible example is the Multilateral Consultation established in 2006 by the IMF in order to provide a forum for the U.S., European Union, China, Saudi Arabia and Japan to discuss the global imbalances problem and to agree upon policy actions to tackle the vulnerabilities concerning each individual member. The Consultation has shown how reluctant to coordinate policy interventions sovereign countries tend to be.

changed since the 80s, thanks to the rapid growth of several emerging markets and to the accelerated process of economic integration in Europe.[7]

It seems thus fundamental that economists and policymakers map the network of economic relationships laying behind global imbalances before setting the features of any policy coordination plan. Global imbalances have characterised both the late 1980s and the 2000s, but are phenomena taking place in diverse environments. We start by looking at the overall net trade imbalances in both decades.

Cline (2005a, p.5) claims that the situation at the end of 2005 was very similar to that in mid-1985: both years featured large and growing U.S. current account deficits, an overvalued U.S. dollar, and the risks of an abrupt adjustment in the dollar exchange rate triggered by exogenous factors. On the other hand, the US dollar touched its peak in 2002, not 2005. Furthermore, in both 1985 and 2002 the overvaluation of the dollar on a trade-weighted basis reflected its bilateral undervaluation against the currencies of many US trade partners. For these reasons we will compare 1985 with both 2002 and 2005.

As to the overall size of the imbalances, they amounted to 2.3% and 3% of world GDP respectively in 2002 and 2005, whereas they were close to 1.5% in 1985: global imbalances in recent years have outgrown those at the time of the Plaza agreement.[8] The number of countries showing significant net trade imbalances has gone up too. In 1985 the countries having a surplus larger than 0.05% of world GDP were 8, and those with a deficit larger than the same threshold only 2. In 2002 these numbers grew to 14 and 4 respectively, reaching 16 and 7 in 2005. This shows that the number of countries with large trade surpluses is bigger in the 2000s than in the 80s, while the number of countries with large deficits remains small.

These observations, although revealing, provide at most a *prima facie* evidence of the growing complexity in the global trade-imbalances network. The problem is that so far we have neglected all bilateral balances as much as the interdependence between countries. On these grounds, we move to a complex network approach to shed light on the international trade imbalances networks both in the 1980s and in the 2000s.

[7]We instead overlook the objection that exchange rate coordination is unlikely to be effective in a context of free capital movements. As shown by Klein et al. (1991) and Fratzscher (2008a), in fact, coordinated intervention can be useful through various channels.

[8]This is consistent with Baclet et Vidon (2008) who document the profound change in the global distribution of net imbalances over the last three decades.

3 Network Analysis

3.1 A telegraphic introduction

Sociologists and psychologists have employed network analysis for the study of social interactions among people and groups since the beginning of the last century. Pioneering studies in this area include those by Milgram (1967) and Granovetter (1974), who studied the networks of social acquaintances and job market interactions. A number of powerful statistical tools for the analysis of network structures emerged outside the realm of social sciences thanks to the contributions of physicists, mathematicians, and computer scientists. Such methodological advances have then been applied to social analysis in recent studies by Goyal and Van der Leij (2006); Battiston et al. (2007); Hidalgo et al. (2007); Kali and Reyes (2007, 2009), where the interactions among academics through co-authorships, trade linkages among countries, networks within the "product space", credit chains, and bankruptcy propagation are analysed using complex networks.

The network of international trade relations (or World Trade Network, WTN) has also been analysed by several authors (Kim and Shin, 2002; Serrano and Boguñà, 2003; Garlaschelli and Loffredo, 2004). These studies show that the WTN is very symmetric, find a core-periphery structure, and suggest the emergence of a "rich club phenomenon" whereby countries that have higher trade intensities trade a lot among themselves. Also, Fagiolo et al. (2008) find that the overall network structure is fairly stationary over time despite the recent wave of globalisation. Serrano et al (2007) look at bilateral trade imbalances and highlight how a small number of connections carries a large part of the fluxes travelling through the network.

Recently, some papers have exploited this kind of analysis to answer more economic-oriented research questions. For instance, Kali and Reyes (2007, 2009) have used a network approach to explain macroeconomic dynamics such as economic growth and episodes of financial contagion.

In the present context, the appeal for using complex network analysis comes from the fact that this approach is able to recover the whole structure of the web of trade interactions and thus the evolution of the web of bilateral trade imbalances. In fact, by focusing on a small number of countries and only looking at few bilateral relations (as customarily done in the literature) one misses the complexity of the overall system.

3.2 Methodology and data

In setting up the trade imbalances network, we have chosen to describe the world net trade relationship as a graph of N nodes, i.e. countries, connected by a set of bilateral links, each representing a trade relationship.[9] While many papers concerned with trade flows have used undirected graphs because of the high symmetry of trade flows (see for instance Fagiolo et al., 2008), here we need consider directed bilateral flows. A link connecting two countries with a bilateral trade imbalance goes, in our representation, from the country in deficit towards the country in surplus. Potentially, from any node there might be both inward-oriented and outward-oriented links: country A may in fact run a deficit with country B (which we call a creditor of A), while having a surplus vis-à-vis country C (which we call a debtor of A).

In what follows we take into account the direction of the trade flows by building two distinct networks: one made of bilateral deficits, the other considering surpluses. A first way to describe international economic integration is to count the number of (in-coming or out-going) links maintained by each node: this measure is referred to as node *in-degree* and *out-degree* in the network literature. If one is instead interested in measuring the overall connectivity of the network, it is possible to look at the density of the graph, which amounts to the number of actual links over the maximum number of possible connections given the number of nodes.

Following Serrano and Boguñà (2003) and Garlaschelli and Loffredo (2004) we also investigate whether low degree nodes have the tendency to establish relations with partners characterised by high (or low) degree. The literature suggests that this feature is relevant for the diffusion of whatever flows through the network. The correlation between the degree of a node and the average degree of its partners (*average nearest neighbour degree*, or ANND) delivers the statistical information on this characteristic of the network. If the correlation is positive, one is in presence of an assortative graph, where nodes tend to establish links with partners with similar level of connectivity; otherwise the network is said to be disassortative.

Trade links are characterized by strong heterogeneity in their intensity: to take this into account we need to discriminate among strong and weak links: we do so by weighting each connection by the value of the trade imbalance it represents. The relevant network statistics can be extended and applied to a weighted version of the network. Node *in-* and *out-strength* are the sum of weights associated with the links held by any node. The larger the strength of a node, the stronger its participation in international markets. To investigate the amount

of heterogeneity in economic relationships we can associate to each node a Herfindahl-Hirschman concentration index, which increases in the heterogeneity of link intensities. Furthermore, we study the degree of network assortativity from a weighted perspective by looking at the correlation between strength and *average nearest neighbour strength* (ANNS).

We exploit data from the COMTRADE database compiled by the World Bank. We use both import and export flows to compute bilateral net trade positions, i.e. bilateral surpluses or deficits. All data are expressed in million of USD. For each pair of countries we have 4 potential trade flows, since each exchange is reported as an import by the destination countries and as an export by the source country. In principle we can therefore build two measures for each bilateral net position: as usual, the two measures never match. Moreover, not all the countries appear in the database as both reporter and partner so that not always all the information is actually available. To minimise measurement errors, whenever possible we average across the two measures of trade imbalance.

We end up with a sample of 134 countries in 1985, which rises to 160 in 2002 and 2005. This change in sample size is due to three factors: i) the intensification and the liberalisation of international trade; ii) the political fragmentation of several countries during the 1990s, especially in Eastern Europe and in the former Soviet Union; iii) the improvements in data availability in several developing countries.[10]

3.3 Network results

Node Degree

As said, the number of nodes/countries analysed in the network increases over time, moving from 134 in 1985 to 160 in the 2000s. Nonetheless, the network density, i.e. the number of active links over the maximum possible number of relations given the number of players, has also risen. This means that trade relationships have grown faster than trading countries so that in the last 20 years globalisation has not only implied that more countries trade, but (and especially) that countries trade with a larger number of partners.

Table 1 reports summary statistics for node in- and out-degree. This is the simplest network characteristic and it associates with each node (country) the number of partners with which it runs a surplus or a deficit. Hence, to stick to our previous labels, in-degree

[9]See Fagiolo et al. (2009) for a more detailed exposition of network concepts.

[10]In what follows we will not investigate to what extent each of these reasons accounts for the enlargement of the trade imbalances web. Even though it could be interesting to distinguish the relative contribution of data availability from that of larger and more diversified exchanges of goods and services, data availability and trade intensity are likely correlated.

represents, for each country, the number of its debtors while out-degree the number of its creditors. Results for density are confirmed by the larger mean and median values of node in- and out-degree over time. This pattern holds both looking at absolute values and in terms of the total number of potential partners in the sample (reported in parenthesis in Table 1).

Table 1: Summary statistics on node degree

	1985	**2002**	**2005**
Nodes	134	160	160
Density	0.235	0.332	0.334
In-degree: mean	31.32 (23%)	52.86 (33%)	55.31 (35%)
In-degree: median	22.00 (17%)	45.00 (28%)	48.50 (30%)
In-degree: st. dev.	24.67	34.09	34.87
In-degree: max	101 (76%)	128 (80%)	131 (82%)
In-degree: min	1	4	5
Out-degree: mean	31.32 (23%)	52.86 (33%)	55.31 (35%)
Out-degree: median	29.00 (22%)	51.00 (32%)	54.00 (34%)
Out-degree: st. dev.	15.49	17.17	17.47
Out-degree: max	79 (60%)	100 (63%)	94 (59%)
Out-degree: min	5	10	14

Number in parentheses are relative to max number of possible links

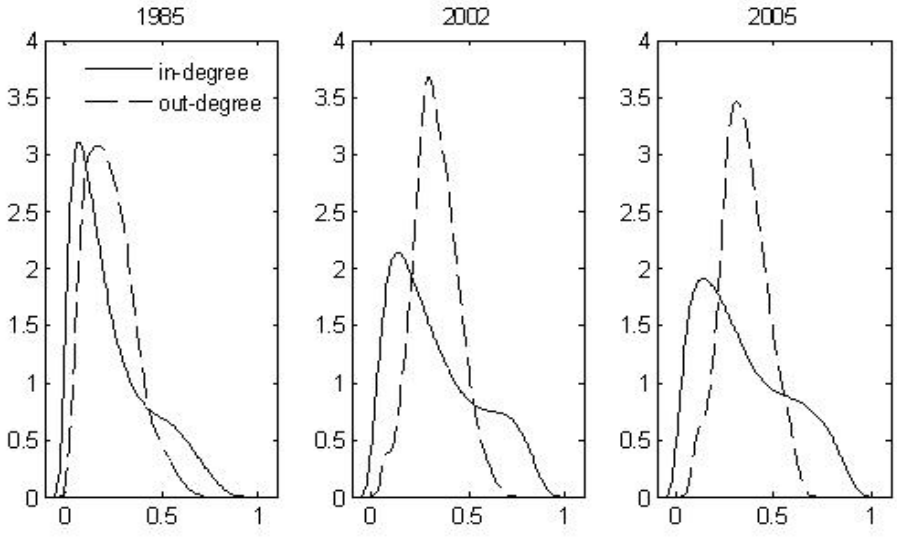
In the 1985, the median country has a surplus against almost 22 partners and a deficit with 29; in 2002 and 2005 the median country has a surplus with 45–48 countries and a deficit with 51–54. While the mean and median values of out-degree (i.e. number of creditors) are close, the mean value of in-degree (i.e. number of debtors) remains higher than the median one in all years. This implies that most countries have only few debtors, but some have surpluses with a numerous set of partners. This is confirmed by the fact that the maximum value of in-degree is larger than that of out-degree. These results represent a first additional piece of evidence about the increasing complexity of the trade imbalances network over time.

Figure 2 reports the distribution of normalised in- and out-degrees for 1985, 2002 and 2005.[11] One can notice that the distribution of in-degree is relatively more skewed (to the right) than the distribution of out-degree. Moreover, such asymmetry falls from 1985 to 2005 in both cases. Hence, consistently with the descriptive statistics discussed above, Figure 2 shows that countries tend to run surpluses and deficits with an increasing number of partners over time, thus corroborating the idea of increasing complexity. A formal test

[11]The normalisation is meant to offset the change in the number of countries analysed over the years.

for the equality of the distributions rejects the null hypothesis and supports the visual intuition that the distributions of both in- and out-degree have changed from 1985 to the 2000s.

Figure 2: Degree distribution



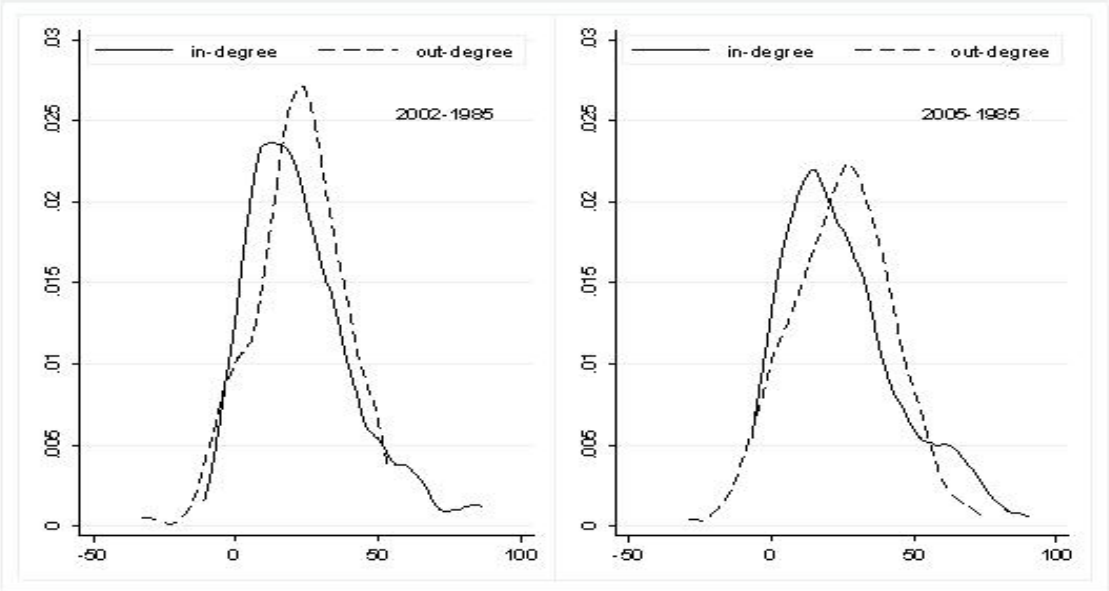
Interestingly, Figure 2 shows that the distribution of in-degrees spans a wider support, something that one can appreciate also by looking at the ranges of in- and out-degree in the descriptive statistics summarised in Table 1. There, in fact, it appears that the difference between the maximum and minimum values taken by in-degree is larger than in the case of out-degree. Similarly, while the average number of both incoming and outgoing links has increased over time, the corresponding standard deviation has remained stable in the case of the latter, while increasing markedly for the former. This result is the likely outcome of the new and increased role played by a group of emerging countries (mainly exporting primary commodities) that in recent years display trade surpluses with many partners.

In Figure 3 we plot the distribution of the change in in- and out-degree between 1985 and 2002/2005. One can see that the mode of the distribution corresponds to higher values in the case of out-degree: this suggests that —for the representative country— the increase in the number of creditors is larger than the increase in the number debtors or, to put it differently, that the number of partners with whom the representative country runs a deficit has grown more than the number of countries with whom it runs a trade surplus.

A further change in the topology of the network of trade imbalances is testified by the correlation between in- and out-degree. Positive and significant in 1985 (equal to 0.45), the correlation turns negative in 2002 and 2005, taking values of -0.13 and -0.24. Hence, while in the mid 1980s countries with many debtors tended to have also many creditors, in more

recent years a large number of debtors is associated with a small number of creditors. This is consistent with the previous findings suggesting that the number of bilateral deficits run by each country has grown faster than the number of surpluses. Also, we find that while there is not statistical relation between the overall net position of a country and the number of its debtors, larger deficits are associated with many creditors, and that this feature is strengthening over time.

Figure 3: Difference in degrees



Average Nearest Network Degree

The number of partners a country is related to is often a good signal of its importance in the network. Nonetheless, the relevance of two countries exhibiting the same node-degree statistics may differ according to the degree of connection of their respective partners. In an undirected network a measure that is often employed to quantify how a country's partners are themselves connected is the average nearest-neighbour degree (ANND). For each node, ANND measures the average number of links maintained by its partners and, therefore, it deals with 2-step away relationships. In the present context this metrics does not say much about the nature of the relationships between each pair of partners: in a directed network, each country is, at the same time, potentially creditor to some partners and debtor to others. Rather than grouping them all together, we would like to distinguish between creditors of one's creditors, creditors of one's debtors, and so on. Accordingly, there are

four possible variants of the average nearest-neighbour degree that can be used in a directed framework.[12]

Table 2: Summary statistics on ANND

		1985		
	$ANND^{in,in}$	$ANND^{out,out}$	$ANND^{in,out}$	$ANND^{out,in}$
mean	43.129	38.423	41.086	53.392
median	41.833	38.351	40.859	54.001
st. dev.	14.082	6.237	6.329	10.292
max	77.667	56.4	55.222	73.429
min	19.619	24.283	25.417	28.889
		2002		
	$ANND^{in,in}$	$ANND^{out,out}$	$ANND^{in,out}$	$ANND^{out,in}$
mean	42.799	38.244	41.372	55.063
median	40.364	38.611	41.138	55.429
st. dev.	13.431	5.368	6.466	10.487
max	90	53	63.571	78.667
min	11	24	22	29.469
		2005		
	$ANND^{in,in}$	$ANND^{out,out}$	$ANND^{in,out}$	$ANND^{out,in}$
mean	55.095	51.127	58.185	74.835
median	52.818	51.623	58.409	75.168
st. dev.	12.487	3.473	2.976	8.058
max	98.938	57.833	66.8	98.5
min	30.556	41.396	46.625	54.778

For each country one can in fact look at a) the debtors of one's debtors; b) the creditors of one's debtors; c) the debtors of one's creditors; and d) the creditors of one's creditors. We label these four measures as $ANND^{in,in}$, $ANND^{in,out}$, $ANND^{out,in}$, $ANND^{out,out}$, where the superscript indicates the country of reference and the subscript the type of relation maintained by its partners.[13] Table 2 summarises some descriptive statistics for the 4 indices. One can see that mean and median values always increase over time, while the standard deviation takes smaller values. This is consistent with a process of generalised increased interconnectedness among countries.

The correlation coefficients between the incoming and outgoing links and *ANND*s provide some additional insights. This information is summarised in Table 3: the correlations are all negative and significant in 1985. Thus, for instance, countries with many creditors (high out-degree) tend to run deficits with partners that, on average, are characterised by few bilateral surpluses and deficits. The same applies to countries running

[12]To the best of our knowledge, these four metrics have never been used in the literature so far.

many trade surpluses (high in-degree) in 1985. In network analysis such a negative correlation is usually interpreted as a signal of a hierarchical structure in the network since it suggests the existence of a subset of more central nodes connected with many partners and a periphery of players linked with the hubs, but scarcely connected among themselves. For three out of our four correlations the sign remains the same over the years, and although the values get smaller (in absolute values) they are always significantly different from zero. On the contrary, the correlation between out-degree and $ANND^{out,out}$ becomes positive in 2002 and further increases in 2005. Hence, we observe that in the 2000s countries running many bilateral deficits tend to be connected with partners that also run a large number of trade deficits.

Table 3: Degree-ANND correlation coefficients

1985				
	$ANND^{in,in}$	$ANND^{out,out}$	$ANND^{in,out}$	$ANND^{out,in}$
in-degree	-0.57		-0.62	
out-degree		-0.52		-0.72
2002				
	$ANND^{in,in}$	$ANND^{out,out}$	$ANND^{in,out}$	$ANND^{out,in}$
in-degree	-0.46		-0.39	
out-degree		0.25		-0.38
2005				
	$ANND^{in,in}$	$ANND^{out,out}$	$ANND^{in,out}$	$ANND^{out,in}$
in-degree	-0.42		-0.16	
out-degree		0.44		-0.38
All coefficients are significant at 5%				

Weighted Analysis: Node Strength and ANNS

Fagiolo et al. (2009) have shown that limiting the analysis to a binary characterisation of the network can lead to overlook relevant information about its structure. Although the reflection focuses here on the increased complexity of the web of bilateral net trade, and therefore it is concerned more with the number of players than with the size of their imbalances, one cannot disregard this latter aspect. To look at the weighted version of the network, we attach to each link a weight equivalent to the size of the trade imbalance it

[13]Thus, $ANND^{in,in}$ measures the number of debtors of one's own debtors and $ANND^{out,in}$ the number of debtors of one's own creditors. It is worth noticing that the country of reference is excluded from the count of its own debtors/creditors' partners.

represents: relationships cease to be treated as homogeneous (as we have done so far), but are evaluated on the basis of their importance (i.e. magnitude). The weighted counterpart of node degree is node strength. The distribution of node strength is, as usual, very skewed as the vast majority of bilateral trade imbalances is very small.

Table 4 reports summary statistics for node strength. We see that mean and median values have significantly increased, not only between 1985 and the 2000s, but also between 2002 and 2005. Heterogeneity across links has also grown markedly, something that suggests how treating all relationships as equal can be misleading. (From the Table 4 one can also appreciate how the median deficit is substantially larger than the median surplus.)

Table 4: Summary statistics on node strength

	1985	2002	2005	1985	2002	2005
	In-strength			Disparity		
mean	3384.00	9655.72	17754.69	0.30	0.25	0.29
median	374.12	879.14	1558.07	0.23	0.18	0.20
st. dev.	9305.91	24644.93	46193.55	0.22	0.20	0.31
max	88565.40	176967.08	409481.27	1.00	0.96	0.96
min	0.02	0.11	2.69	0.05	0.03	0.03
	Out-strength			Disparity		
mean	3384.00	9655.72	17754.69	0.20	0.17	0.22
median	533.53	1920.18	3885.65	0.17	0.12	0.14
st. dev.	12214.04	38337.80	65227.92	0.12	0.14	0.27
max	132977.51	460040.79	770254.82	0.74	0.83	0.83
min	6.31	33.05	52.38	0.05	0.04	0.04

Figures in million USD (except Disparity, which is an index number)

We can assess more precisely the degree of heterogeneity by looking at node disparity, which is nothing else than a Herfindhal-Hirschman concentration index applied to the strength of each country's relationships. Thus, larger values imply larger concentration of bilateral trade imbalances or, in other words, that a small number of links account for the majority of a country's overall trade imbalances. It appears that disparity is consistently higher for incoming links (i.e. surpluses) than for outgoing ones (i.e. deficits), suggesting that deficits tend to be more evenly distributed. This result is consistent with what previously found also for node degree.

As to correlations, in- and out-strength are positively correlated. Furthermore, the correlations between in- and out-degree and the corresponding strengths are, as expected, positive: countries with many creditors tend to run larger bilateral deficits.

In a similar fashion as before, we can look at 2-step away relationships by means of ANNS. These measures allow to analyse the condition of each country's partners. The correlation analysis (not reported) suggests that partners of countries running large surpluses are characterised by small surpluses and large deficits. Similarly, countries running large bilateral deficits tend to be connected to partners that also display large deficits or small surpluses.

An interesting way to look at degree and strength at the same time is to work with the ratio of out- over in-degree and the ratio of out- over in-strength for each country. After normalisation, each of the ratios ranges between 1 and -1: they take a positive value if the country has more creditors than debtors (in the case of node degree) or if it is running an overall trade deficit (in the case of node strength). Focusing on the ratios between out- and in-strength, it can be noticed that both the mean and median values are positive and increase over time. Also, the number of countries in surplus in 1985 that turn into deficit in 2002 is larger than the number of countries moving in the opposite direction (19 Vs. 11).

Figure 4 combines these two ratios and identifies the dynamic of a few selected countries between 1985 and 2005. The two panels of the figure are divided in four parts: in the upper left quadrant there are countries that run an overall trade deficit and are also characterised by a number of debtors larger than the number of creditors (in-degree larger than out-degree). Similarly, in the upper right part one finds countries that have more creditors than debtors while running an overall trade deficit. The interpretation of the bottom quadrants is similar, save for the fact that countries displaying an overall trade surplus are clustered there.

Some countries do not change quadrant over time: Germany, Japan, France and the US display little or no change at all. The first two countries keep running trade surpluses and having a large number of debtors, France remains in deficit but increases its debtors more than its creditors, while the US runs bilateral deficits with many countries, something that makes it an overall debtor. Other countries, instead, modify their situation. One of the most significant changes concerns China that, not surprisingly, moves from a deficit to a surplus position and increases the overall number of its creditors.

Big players in the network

Having discussed the position of a few key players we now turn to the picture of the whole network of trade imbalances, as represented in Figure 5. A few features emerge quite clearly from this graphical representation: in 1985 the centre of the stage is taken by (current) G7 countries, which dominate the scene and which we have highlighted by putting them in the

middle of the graph. The main trade imbalance is the deficit of the US versus Japan, which in fact was one of the triggers of the Plaza agreement. The contribution of countries not belonging to the G7 club is very limited and mainly due to Hong Kong, which at that time operated as a platform to/from China, and Saudi Arabia because of its oil exports. The picture changes in 2005 and, consistently with what discussed above, the number of important players increases. Previously peripheral economies such as China and Mexico rise to the stage and, in particular, the relationship between China and the US shadows all other links. Germany reinforces its position as a global creditor, while the UK moves in the opposite direction becoming a global debtor.

Table 5 reports the values for a number of selected economies. In terms of node degrees, the US in 1985 has almost the same number of creditors and debtors (around 60). Over the years, thanks to the globalisation process and to the extension of its trade network, both its creditors and debtors increase in number. The group of debtors grows to 72 and creditors reach 86 in 2002. In 2005 the US has 91 creditors and 68 debtors. A movement in the opposite direction characterises China that, over the last 20 years, doubles the number of its bilateral surpluses (from 59 to 121), while slightly reducing the number of countries against which it runs a trade deficit.

Figure 4: Selected countries trade-imbalances ratios

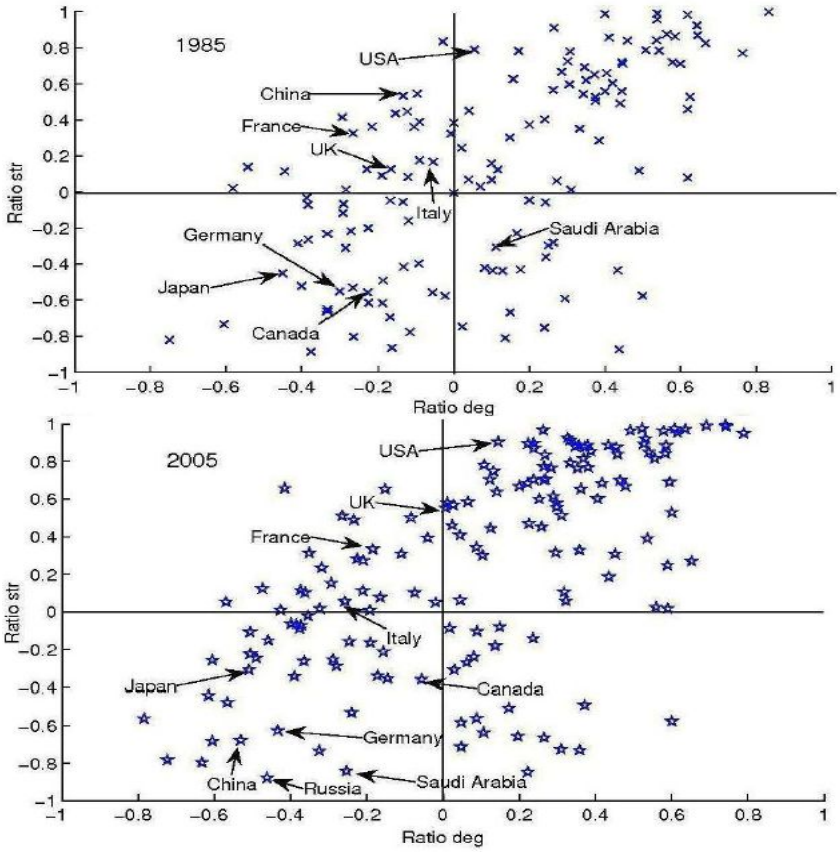


Figure 5: The network of trade imbalances in 1985 and 2005

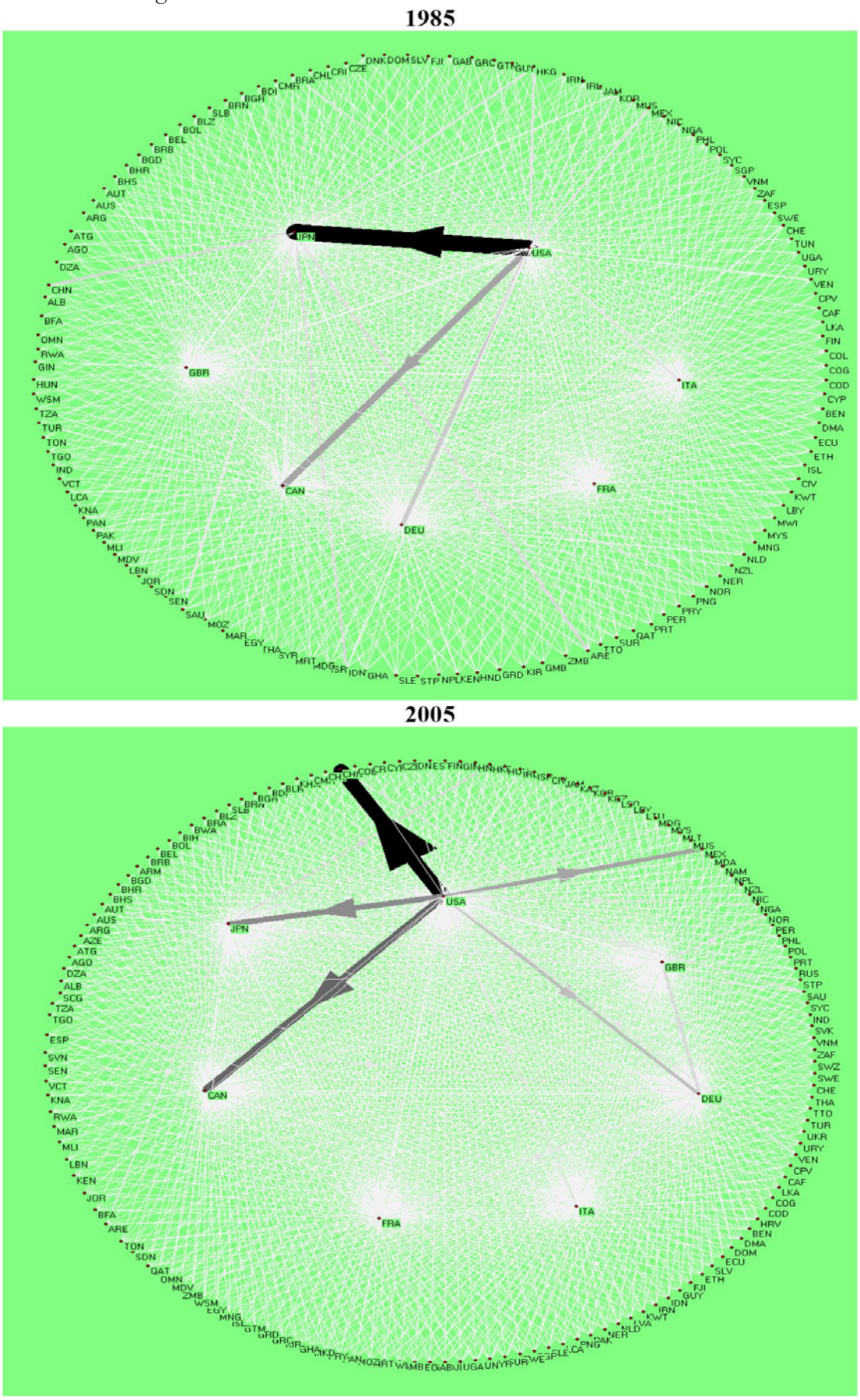


Table 5: Network indicators for selected countries

Country	In degree	Out degree	In strength	Out strength	Net trade balance
			1985		
Brazil	77	11	14 542.49	1 438.72	13 103.77
Canada	70	44	20 676.12	5 879.65	14 796.47
China	59	45	4 555.88	14 980.44	-10 424.56
France	83	48	9 229.97	18 185.77	-8 955.81
Germany	86	46	47 783.42	13 864.16	33 919.27
Hong Kong	87	23	9 342.18	9 757.99	-415.81
Italy	67	60	12 214.09	17 134.43	-4 920.34
Japan	95	36	88 565.40	33 538.87	55 026.53
Korea	59	42	8 185.59	7 457.87	727.72
Mexico	62	36	10 890.62	1 190.57	9 700.06
Saudi Arabia	28	35	12 866.20	6 841.53	6 024.67
UK	77	55	15 197.01	19 630.65	-4 433.64
USA	61	68	15 546.71	132 977.51	-117 430.80
			2002		
Brazil	122	26	21 359.17	7 842.02	13 517.15
Canada	84	74	66 964.62	28 610.72	38 353.90
China	117	38	176 967.08	28 244.00	148 723.08
France	106	53	39 340.59	45 122.93	-5 782.34
Germany	111	48	150 884.05	27 026.72	123 857.33
Hong Kong	101	50	23 349.64	78 406.76	-55 057.11
Italy	109	50	53 048.59	42 858.48	10 190.11
Japan	108	51	162 135.20	59 062.29	103 072.91
Korea	120	39	53 714.00	37 918.83	15 795.17
Mexico	51	86	40 440.52	30 907.28	9 533.24
Saudi Arabia	79	43	38 623.56	8 771.37	29 852.19
UK	82	77	22 169.78	85 859.77	-63 690.00
USA	72	86	26 305.94	460 040.79	-433 734.85
			2005		
Brazil	131	21	55 851.88	6 851.31	49 000.56
Canada	84	75	104 168.86	49 222.19	54 946.67
China	121	37	409 481.27	78 875.51	330 605.76
France	93	64	48 768.69	97 644.24	-48 875.55
Germany	114	45	257 378.93	59 334.43	198 044.50
Hong Kong	109	45	26 895.16	130 866.10	-103 970.94
Italy	100	59	81 142.93	90 742.46	-9 599.53
Japan	120	39	219 519.25	116 464.97	103 054.28
Korea	126	31	107 823.71	63 923.23	43 900.48
Mexico	58	94	66 887.90	50 487.97	16 399.93
Saudi Arabia	89	53	122 868.68	10 662.87	112 205.81
UK	79	80	43 806.32	152 754.86	-108 948.54
USA	68	91	38 650.70	770 254.82	-731 604.12

4 Trade imbalances-weighted effective exchange rates

4.1 Motivations and methodology

The complexity of the network of trade imbalances bears not only on the difficulty to orchestrate a multilateral plan of interventions to redress such imbalances, but also on the synthetic measures normally adopted to track the evolution of exchange rates over time. In particular, in what follows, we shall focus on the nominal effective exchange rate (EER), that is a synthetic way to seize the evolution of a currency vis-à-vis its bilateral exchange rates (see MacDonald, 2007 for a discussion). As we shall endeavour to show, trade-weighted EERs do not allow to appraise whether the movements of the bilateral rates are consistent with the simultaneous closure of all the bilateral trade imbalances. This observation casts some doubts on the appropriateness of traditional EERs as indicators of the evolution of the exchange rates in a context of widespread and large imbalances.

In general, the EER is a weighted average of a basket of bilateral exchange rates.[14] The choices of the currency basket, the weighting scheme, the base period and the updating method (in case of time-varying weights) touch on the EERs: central banks and international institutions have developed various alternative indices, which precisely differ in one or more of these dimensions.[15]

In most cases, researchers have developed EERs which serve as indicators of countries' level of competitiveness. In such a case, the ideal approach to build EERs would be to use a global model-based weighting scheme of bilateral trade flows. The high degree of complexity of such theoretical approach, however, has led researchers and policymakers to rely on simpler indices (based on actual trade flows) that nonetheless give a qualitative picture of the movements in the level of countries' competitiveness. Among these indices, the most common schemes to weight bilateral exchange rates are the global, bilateral and double weighting approaches. The BIS trade-weighted effective exchange rate index (TWI hereafter) is built along this method. The broader basket composition of the TWI currently encompasses 52 economies (see Klau and Fung, 2006).

[14]Among the first works endorsing EERs we recall Artus and Rhomberg (1973), Black (1976) and Hooper and Morton (1978).

[15]Several existing indices, for instance, differ in terms of the scope of their currency basket. This is due to the fact that currency baskets are not based on a single theoretical foundation and are also influenced by data availability and integrity.

The variety of EER measures is not exclusively the product of competition among research centres. In fact, the very concept of EER is not univocally defined and can be declined according to the economic issue to analyse. In particular, the choice of the weighting scheme and the basket of currencies hinges on the phenomenon under scrutiny.[16] This is clearly illustrated by the fact that, besides various trade-weighted EERs, researchers also developed capital-weighted EERs (Makin and Robson, 1999).

Since country competitiveness is usually the issue addressed by EERs, the indices do not take into account trade imbalances, but gross trade flows. It follows that such EER measures, while usefully condensing in a unique figure the average evolution of various bilateral exchange rates, do not help to discern whether exchange rates move so as to close bilateral and overall trade imbalances. The question, then, is whether it would be possible to build alternative EER indices which take into account bilateral trade imbalances, rather than competitiveness.

Positive and negative bilateral imbalances are to be treated separately if one wants to build EER measures that convey information about both exchange rates and trade imbalances. Accordingly, we build two imbalances-weighted indices and use them to look at the evolution of the exchange rates during 2002–2006. SWI is a surplus-weighted EER index. In the SWI for country *i*, the basket includes all the currencies of the countries which the country *i* has a trade surplus with. The currency of country *j* enters in the SWI for *i* weighted by the ratio of country *i*'s bilateral trade surplus with *j* over country *i*'s overall surpluses. DWI is a deficit-weighted EER index: the calculation of such EER for country *i* is based on a basket including all the currencies of the countries which country *i* has a deficit with. The weigh attached to the currency of country *m* is proportional to ratio of the bilateral trade deficit of *i* with *m* relative to *i*'s total deficits.

Having set the criteria to form the baskets of currencies entering into the SWIs and the DWIs, a decision need be made in terms of i) the extension of the overall sample of currencies, and ii) the year of reference for the weights. Starting with the latter, we decide to use the bilateral trade imbalances in 2002 to build the weighting schemes. To allow comparability, all indices are then normalised and set equal to 100 in 2002. As to the composition of the samples, we will adopt two: one (which we call broad) consists in the entire set of countries considered in Section 3 (i.e. 160 countries); the other (narrow) is the BIS sample of countries for which we have trade and exchange rate data (that is 49

[16]See Turn and Van't dack (1993); Klau and Fung (2006); Erlandsson and Markowski (2006) on this.

countries).[17] The former measure will bring into the picture the complexity of the network of imbalances, while the latter will be used to compare to which extent SWIs and DWIs diverge from the TWIs calculated by the BIS, once an (almost) equivalent sample is used to build the indices. Notably, the main message of our exercise does not change with the adopted sample of countries and should not be attributed to the extension of the basket to an unusually large number of foreign currencies.

While our statistical analysis will be based on the entire samples at hand, for the sake of keeping tables and graphs readable, in what follows we shall discuss the indices for a limited number of countries. As explained above, however, they do not coincide with the baskets and the samples used to calculate the indices.

4.2 The evolution of the exchange rates in the 2000s

Tables 6 and 7 reproduce the SWIs and DWIs for a subsample of 24 countries.[18] We report both broad indices including 160 countries (Table 6) and narrow indices taking in the 49 countries that belong to the BIS sample (Table 7). In addition, the broader TWIs provided by the BIS over the same period are also reproduced. Even though our measures are not directly comparable to those of the BIS because of the differences in the methods used to construct the indices, we shall compare the various measures to see to which extent they convey diverging or compatible information. As before, we shall start with a few statistical findings and then move to analyse the experience of some selected countries.

The correlations between the broad DWIs and SWIs in 2003, 2004, 2005 and 2006 are, respectively, 0.68, 0.47, 0.25, and 0.05. These statistics convey the impression that the movements of SWIs and DWIs are not correlated over the medium term. However, if we focus on the narrow indices, the correlation between DWIs and SWIs remains in all years high and close to 0.75.[19] Broad and narrow indices vary in the same direction (with respect to 2002) in 80–85% of the countries in each year. In particular, the SWIs and DWIs of the

[17]Admittedly, our restricted sample and that used by the BIS do not perfectly coincide. First, we exclude Taiwan and Romania for the lack of trade data. Secondly, while the BIS treats the euro-area as a single entity in computing the EER indices for the other economies and calculates a set of EER indices for each euro-area country taking intra-euro area trade into account, we deal with euro-area countries as independent ones. This complicates the interpretation of the indices for the countries of the area (since there cannot be bilateral exchange rate changes between them in the 2000s, the variability of the indices is limited to the differences in their trade imbalances), but it avoids cancelling out the intra-European trade imbalances.

[18]Both EERs are computed over the period 2002-2006.

[19]In addition, the correlation of the broad indices of only the 49 countries entering the BIS sample is high and close to 0.70.

largest trading countries move in the same direction, whereas those of the remaining countries tend to diverge more often. Notably, this is particularly true for the SWIs.[20]

Both broad and narrow DWIs and SWIs are positively correlated with the TWIs of the BIS. The correlation does decline from about 0.8 in 2003 to circa 0.6 in 2006, but it remains substantial. The pairwise comparison of the direction of change of the narrow indices (with respect to 2002) reveals that in 80% of the cases TWI changes have the same sign as, respectively, those of DWIs and SWIs. The three indices change in the same direction in 60% of the countries in 2003, 70% in 2004 and 2005, and 80% in 2006. These findings suggest that our indices are not at odds with traditional trade weighted EERs and allow to draw additional information. For instance, they reveal that from 2002 to 2006 the exchange rates tended to move not so as to close bilateral imbalances (since this would have required a negative correlation between SWIs and DWIs), but rather the overall imbalances of the single countries.

Table 6: Broad EER indices 2002–2006

		DWI Whole sample				SWI Whole sample			
	2002	2003	2004	2005	2006	2003	2004	2005	2006
Argentina	100	92.6	85.4	86.2	82.2	104.3	98.8	94.8	87.7
Australia	100	110.1	119.4	124	121.1	113.2	122.7	123.9	123.6
Brazil	100	87.7	88.8	106.3	119.8	93.7	95.9	113.6	126.4
Canada	100	104.5	107.4	114	120.7	112	120.6	129.5	138.3
Chile	100	96	107.4	112.4	119.5	96	105.1	113.5	120.6
China	100	99	96.4	92.9	91.3	96.6	94.1	94.7	97.3
France	100	105.8	109	108.8	109	110.9	115	113.9	114
Germany	100	107.6	111.4	111.4	113.3	109.7	113.7	113.1	113.4
Hong Kong	100	96.2	93.3	92.4	91.3	98.2	96.5	96.3	96.3
Ireland	100	111.3	112.7	114	114	106.3	109.5	109.4	109.8
Italy	100	107.5	110.9	110.7	110.5	112.2	117.8	116.7	117.1
Japan	100	105.5	111.7	110.4	103.5	104.9	109.9	106.4	99.6
Korea	100	98.6	98.2	110.5	120.6	103.7	106.5	118.2	125.8
Malaysia	100	93.3	90.6	92.3	95	96.7	94.3	94	96.3
Mexico	100	82.8	74.9	75.9	74.7	89.6	85.5	87.8	87.6
New Zealand	100	110.9	116.8	121.9	112.1	122.3	135.7	140.7	127.8
Norway	100	100.4	99.1	104.4	104.6	101	98	101.9	101.1
Singapore	100	97.6	97.3	99.5	104.5	99.3	100.3	101.5	106.7
South Africa	100	128.6	143.6	144.6	134.4	146.1	182.9	206.9	226.2
Spain	100	106.6	110	110	110.3	107.1	110.3	108.7	109
Sweden	100	102.8	104	102.4	103.4	113.2	119.7	116.3	117.2
Switzerland	100	99.4	98.8	98.6	97.1	112.4	118.6	116.7	115.4
UK	100	96.9	102	100.7	101.6	104.7	114.3	112.6	113.1
USA	100	95.5	92.2	90.9	89.8	92.2	87	86	86.1

DWI and SWI calculated on baskets of 160 countries. Reference year 2002.

[20]The correlation between broad and narrow SWIs falls over time (from 0.77 to 0.54), whereas it remains almost constant and close to 1 (i.e. 0.97) in the case of broad and narrow DWIs.

Table 7: Narrow EER indices 2002–2006

		DWI				SWI				TWI			
	2002	2003	2004	2005	2006	2003	2004	2005	2006	2003	2004	2005	2006
Argentina	100	92.4	85.1	86	82	101.2	94.2	89.7	82.3	107	103	102.8	101.4
Australia	100	109.5	118.3	122.8	119.9	109.6	116.6	116.6	116.5	112.7	121.6	125.2	124.8
Brazil	100	84.5	85	101.7	115.6	90.2	90.9	107.7	119.3	96.9	101.2	125.4	140.6
Canada	100	103.7	106.3	112.4	118.9	112	120.6	129.4	138.3	110.3	115.8	122.7	129.6
Chile	100	95.5	106.7	111.5	118.7	94.2	102.2	110.5	117.4	93.8	100	105.7	110.1
China	100	96.1	92.4	87.5	85.3	96.2	93.6	94.1	96.6	93.2	90.5	89.5	90.9
France	100	103.9	106	105.6	105.6	108.8	111.6	110.1	109.9	106.1	108.2	106.8	106.1
Germany	100	104.9	107.1	106.5	107.9	107.9	110.9	110.3	110.4	105.9	107.7	105.6	104.7
Hong Kong	100	96.2	93.2	92.3	91.2	97.5	95.4	94.9	94.6	90.7	84.7	82.4	81.4
Ireland	100	110.6	111.1	111.5	110.7	105.9	108.9	108.7	109.2	110.6	114	113.6	115.6
Italy	100	103.4	104.8	104.4	104	111.3	116.2	114.8	115.1	106.5	108.5	106.9	106.6
Japan	100	99.6	103.1	101.7	94	104.5	109.3	105.7	98.8	100.2	101	94.8	85.8
Korea	100	94.9	92.2	104.1	115	102.7	105	116.2	123.2	100.8	102	114	122.1
Malaysia	100	92.6	89.6	91.3	93.9	96	93.3	92.7	94.8	94.3	89.9	90	93.3
Mexico	100	82.6	74.7	75.7	74.5	88.7	84.4	87	86.5	88.7	84.7	87.8	87.9
New Zealand	100	108.7	113	117.5	107.9	120.6	132.8	137.3	123.6	114.7	123.4	130.4	121.2
Norway	100	97.7	94.8	99.5	98.6	100.3	97	100.9	100.1	99.7	95.5	98.6	98.3
Singapore	100	95.6	94.1	96.6	101.7	98.2	98.4	98.9	103.6	96.2	95.1	93.8	95.8
South Africa	100	122.4	133.3	133.5	123.4	126.3	137.5	139.1	130.4	131.8	143.7	145.7	139.9
Spain	100	103.9	105.9	105.5	105.6	103.9	105.1	104.1	103.9	105.8	108.4	108.9	110.4
Sweden	100	101.7	102.2	100.3	101.2	111.7	117.3	113.6	114.2	106.4	106.8	102	101.3
Switzerland	100	97.8	96.6	96.2	94.4	111	116.4	114.1	112.7	100.5	99.5	97.4	94.7
UK	100	96.4	101	99.3	99.6	100.9	108.3	106.3	106.5	96	99.7	97.7	98
USA	100	93.8	89.9	88.2	86.9	83.6	75.1	73.7	73.8	93.8	89.6	88.2	87.6

DWI and SWI calculated on baskets of 49 countries. TWI (BIS) calculated on a basket of 52 countries. Reference year 2002

It should be noted that this conclusion bears some implications for the issue we addressed in Section 3 of the paper. The very fact that bilateral exchange rates do not change so as to close the bilateral imbalances means that the uncoordinated exchange rate movements observed in recent years cannot be presumed to have worked for the simultaneous adjustment of the imbalances of all countries. Clearly, this observation has no direct normative implications on the desirable evolution of the exchange rates, in that we do not claim that the ER should move so as to actually close all bilateral imbalances. Short of that, our analysis mainly aims to show that this has hardly happened so far and that stronger coordination is needed if one believes, as the advocates of the new Plaza implicitly do, that the reduction of the bilateral imbalances is a sensible goal.

Admittedly, as can be seen in Tables 6 and 7, the patterns of DWIs and SWIs, on the one hand, and the TWIs, on the other, sensibly diverge for three countries: Argentina, Japan and Singapore. In the case of Japan, this is particularly significant for the DWI measures and probably due to the limited number of creditors the country has. In the case Argentina and Singapore, instead, no simple explanation can account for the divergence. However, we argue, this might not be a real problem. Our indices, in fact, mirror the EERs calculated by the central banks of those countries, i.e. the Multilateral Real Exchange Rate Index calculated by the Central Bank of Argentina and the NEER of the Singaporean dollar elaborated by the Monetary Authority of Singapore. This result is encouraging given that the MAS monetary policy is an exchange rate-based policy, that is a managed float against a basket of foreign currencies.

We find no statistically significant association in the direction of change of the SWIs and DWIs, on the one hand, and, the overall trade balances, on the other hand.[21] This does not mean that exchange rates did not affect trade imbalances at all. Several reasons may in fact account for the apparent independence in the data. The first explanation is that changes in nominal exchange rate may not be as effective as those in real exchange rates in affecting trade balances. Moreover, the impact of exchange rate variations on trade balances ultimately depends on the demand and supply elasticities, which differ across countries and goods: there is therefore no theoretical reason to expect the existence of a one-to-one relationship between the changes in the exchange rates and those in the trade balances.

We move now to consider the evolution of the indices for a few currencies and we plot the DWIs and SWIs for China and the G7 countries in Figure 6. The US dollar, around

[21]The Fisher exact test, the likelihood ratio G2 statistics and the Chi square Pearson statistics fail to reject the null hypothesis that the changes in the indices and in the trade balance measures are independent.

which any international adjustment process must revolve, did depreciate against foreign currencies in the period 2002–2006. The depreciation was larger towards the currencies of the debtors, rather than the creditors of the US. This finding, which maybe due to the very limited appreciation of the Chinese renmimbi over this time period, confirms that the depreciation of the dollar was not mainly directed towards the countries against which the US was running its largest deficits. Thus, it is not a case that, notwithstanding the overall depreciation of the dollar on a trade-weighted basis, neither the US gross bilateral imbalances nor its overall deficits were reduced in the time span 2002–2006. The appreciation of the euro and the Canadian dollar against the US dollar was not sufficiently ample to outweigh the movements of the currencies of China, Hong Kong, Japan, Mexico and Saudi Arabia.[22]

We move now to consider the evolution of the indices for a few currencies and we plot the DWIs and SWIs for China and the G7 countries in Figure 6. The US dollar, around which any international adjustment process must revolve, did depreciate against foreign currencies in the period 2002–2006. The depreciation was larger towards the currencies of the debtors, rather than the creditors of the US. This finding, which maybe due to the very limited appreciation of the Chinese renmimbi over this time period, confirms that the depreciation of the dollar was not mainly directed towards the countries against which the US was running its largest deficits. Thus, it is not a case that, notwithstanding the overall depreciation of the dollar on a trade-weighted basis, neither the US gross bilateral imbalances nor its overall deficits were reduced in the time span 2002–2006. The appreciation of the euro and the Canadian dollar against the US dollar was not sufficiently ample to outweigh the movements of the currencies of China, Hong Kong, Japan, Mexico and Saudi Arabia.[23]

[22]This, in a way, corroborates the observation that the dollar has remained considerably overvalued on a trade-weighted exchange rate basis also because the pattern of its devaluation has been inappropriate. This is consistent with Fratzscher (2008b) who shows that the movements of European currencies have accounted historically for a share of the adjustment of the US dollar effective exchange rate that is much larger than their weights in the trade-weighted basket of the US dollar.

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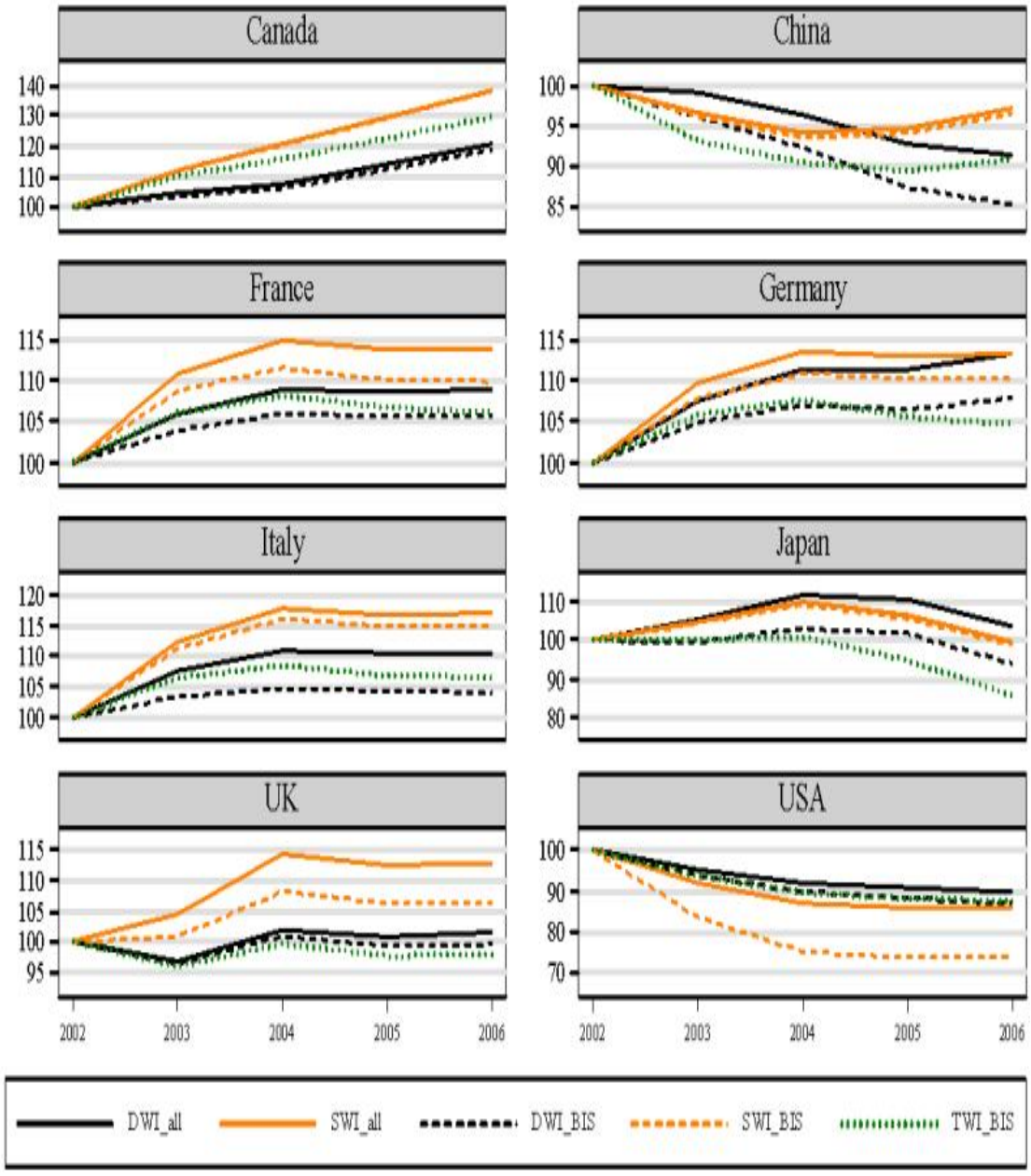
Figure 6: Plot of broad and narrow EER indices 2002-2006



DWI_all and SWI_all calculated on 160 cu 160 currencies. DWI_BIS and SWI_BIS calculated on the BIS sample. Reference year 2002

The Chinese renmimbi depreciated against both creditors and debtors, yet more largely against the former. This finding goes along with the limited depreciation of the US dollar against its creditors and shows that the Chinese authorities effectively prevented their currency from gaining value against the dollar. According to our findings, the Swiss franc appreciated against the currencies of the debtors and depreciated against those of the

effective exchange rate that is much larger than their weights in the trade-weighted basket of the US dollar.

creditors, in a way consistent with the reduction of both positive and negative imbalances. This finding sheds light on why the Swiss overall surplus fell even though its TWI depreciated over time. The UK pound sterling remained almost constant against the creditors of the UK and appreciated against its debtors. It could be argued that this has contributed to the enlargement of the net overall deficit of the country.

The DWIs and SWIs of France, Germany, Ireland, Italy and Spain went in the same direction, most likely because of the appreciation of the euro against several non-European currencies. By the same token, the patterns of the DWIs and the SWIs for these countries mirror those of the TWIs. With respect to TWIs, our indices allow to detect a relatively larger appreciation of the Italian EERs against the debtors of Italy than its creditors; this is consistent with the overall net surplus that the country was running in 2002.

As in the case of Italy, the Canadian dollar, the Korean won, the New Zealand dollar and the Swedish krone appreciated more against the debtors than the creditors of their countries. Notably, notwithstanding the common appreciation of their currencies, Canada, Sweden, Korea and Germany did not reduce their net surpluses by 2005, while Italy and New Zealand did. This finding explains why, as we discussed, there seems not to be any significant association between the variations in the exchange rates and the trade imbalances in the 2000s.

5 Closing Remarks

With this analysis we endeavoured to shed some light on the degree of complexity of the trade imbalances networks in the 1980s and 2000s, which increases along, at least, three dimensions. The first one is the number of nodes, i.e. countries, linked by an unbalanced relationship with their partners. The second one refers to the number of unbalanced relationships that each country entertains. The third one is the increasing degree of heterogeneity in countries' net bilateral positions: a) for the average and median country, the number of creditors progressively outgrows that of debtors, b) the number of countries in surplus with many partners rises (probably because of the performance of the new emerging markets and commodity exporters), and c) the degree of concentration of surpluses is higher than that of deficits.

This map of the trade imbalances networks in 2002 and 2005 informs policymakers in, at least, three ways. In the first place, it reveals that the existence of a parallelism between 1985 and the 2000s cannot be given for granted in all dimensions. Differences are

numerous, difficult to ascertain and relevant for any adjustment process. In the second place, the number of players significantly involved in the matrix of bilateral imbalances is nowadays extremely vast. It is not just the network of trade flows that has grown over time, as shown in Fagiolo et al. (2008), but also that of net trade imbalances. Finally, the analysis shows that the group of countries running both numerous and large surpluses is much narrower than that including countries with several and large deficits. This implies that the former should be at the centre of any politically feasible attempt to redress global imbalances. This is at odds with the restrictive group of (mainly industrialised) countries which met so far in order to tackle (or, better, to plan to tackle) global imbalances. Our descriptive analysis thus corroborates the position of those who favour the involvement of a greater number of emerging markets in any international coordination plan, and it also casts some doubts on the effectiveness of any agreement concerning just a handful of countries. Unluckily, such complex coordinated efforts seem hardly conceivable in the currently fragmented international political environment.

Although these findings help assessing the level of complexity of the current trade-imbalances network, they do not say much about the need of arranging an international plan to close the imbalances. In principle, exchange rates could naturally move so as to reduce bilateral unbalanced positions. Traditional effective exchange rates, albeit representing a synthetic tool for seizing the evolution bilateral exchange rate movements, do not help to assess whether this is actually the case. In fact, they fail to take into account the net bilateral trade positions of the various countries. The new effective exchange rate measures we propose here (i.e. DWIs and SWIs) go in this direction. Their evolution suggests that the uncoordinated exchange rate movements occurred between 2002 and 2006 were not conducive to the closure of all bilateral imbalances in a mutually consistent way.

Our new measures are not meant to predict the prospective exchange rate adjustments that one would need to close bilateral and overall imbalances. First, exchange rate movements are not the only (and probably not even the main) determinants of imbalances.[24] Second, our indices do not aspire to represent a summary of all bilateral exchange rates: given that we weight the bilateral rates by the bilateral imbalances, our indices do not consider the currencies of the countries with balanced trade relationships.

[24]International relative prices, domestic public expenditures and, as many argue, transnational capital flows play a role in the determination of trade imbalances as much as important as exchange rates (McKinnon and Schnabl 2006).

This being said, our results improve the understanding of the movements of exchange rates in a context of numerous bilateral trade imbalances. At the general level, for instance, we show that i) traditional trade-weighted measures, by not taking into account the trade balance position of the various trading partners, are of limited help in interpreting exchange rate dynamics, and that ii) the currencies of most countries have tended to appreciate (or depreciate) against the majority of the trading partners, independently from these latter being creditors or debtors.[25]

From these findings one could conclude, as the advocates of the new Plaza do, that only a strong form of policy coordination has chances to produce a balanced adjustment. On the very same grounds, one could argue that coordination should extend to most of those economic policy measures, which can affect trade imbalances.

Our findings, thus, strengthen an apparent paradox inherent in any plan aiming to close global imbalances: the more complicated and far reaching the coordination plan appears to be, the more necessary it becomes so as to ensure that the adjustment occurs in a mutually consistent fashion.

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[25]This intriguing result can be interpreted in two contrasting ways. It could be argued, on the one hand, that it is good that exchange rates move so as to close the overall net trade imbalances, not the bilateral ones. In such a case, the currency of a country with an overall deficit will depreciate against the currencies of all partners so as to boost surpluses and reduce deficits at the very same time. On the other hand, it could be also argued that this solution is not compatible with a

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coordinated multilateral adjustment in which all countries run acceptable trade balances and enjoy sustainable bilateral exchange rates. Clearly, we base our conclusions on the latter interpretation.

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